CERTIFICATE

I, Hajime Kuramasu, residing at 1-1036-14, Ogawa-cho, Kodaira-shi, Tokyo, 187-0032 Japan, hereby certify that I am the translator of the attached document, namely a Certified Copy of Japanese Patent Application No. H09-225434 and certify that the following is a true translation to the best of my knowledge and belief.

Hajime Kuramasu

Signature of Translator

May 12, 2004

Date

[Name of Document] Application for Patent

[Reference No.] POS58556

[Date of Filing] August 21, 1997

[Addressee] Commissioner of the Patent Office

[Int. Cl.] G09G 3/30

[Title of the Invention] ACTIVE MATRIX DISPLAY DEVICE

[Number of Claims] 11

[Inventor]

[Address] c/o Seiko Epson Corporation, 3-5, Owa 3-chome, Suwa-shi, Nagano-ken

[Name] Ichio YUDASAKA

[Applicant for Patent]

[Id. No.] 000002369

[Name] Seiko Epson Corporation

[Representative] Hideaki YASUKAWA

[Agent]

[Id. No.] 100093388

[Patent Attorney]

[Name] Kisaburo SUZUKI

[Telephone No.] 3348-8531 Ext. 2610-2615

[Selected Agent]

[Id No.] 100095728

[Patent Attorney]

[Name] Masataka KAMIYANAGI

[Selected Agent]

[Id No.] 100107261

[Patent Attorney]

[Name] Osamu SUZAWA

[Application Fees]

[Method of Payment] Prepayment

[Prepayment Registration No.] 013044

[Amount of Payment] 21000

[List of Documents Attached]

[Name of Document] Specification 1

[Name of Document] Drawings 1

[Name of Document] Abstract 1

[No. of General Power of Attorney] 9711684

[Proof] Required

[Name of Document] SPECIFICATION

[Title of the Invention] ACTIVE MATRIX DISPLAY DEVICE

[Claims]

[Claim 1] An active matrix display device comprising a display region including a plurality of scanning lines on a substrate, a plurality of data lines extending in the direction perpendicular to the direction of the scanning lines, and a plurality of pixels arranged in a matrix delimited by the data lines and the scanning lines; each of the pixels being provided with a thin film luminescent device having a lead control circuit containing a thin film transistor for supplying a scanning signal to a gate electrode through one of the scanning lines, a pixel electrode, an organic semiconductive film deposited above the pixel electrode, and an opposite electrode deposited above the organic semiconductive film; the thin film luminescent device emitting light based on an image signal supplied from the data line through the lead control circuit; wherein

the region for forming the organic semiconductive film is divided by an insulating-film which is thicker than the organic semiconductive film; and

the insulating film comprises a lower insulating layer which is formed of an inorganic material and is thicker than the organic semiconductive film, and an upper insulating

layer which is deposited on the lower insulating layer and is formed of an organic material.

[Claim 2] An active matrix display device according to claim 1, wherein the upper insulating layer is deposited in an inner region of the lower insulating layer so as to have a width narrower than that of the upper insulating layer.

[Claim 3] An active matrix display device comprising a display region including a plurality of scanning lines on a substrate, a plurality of data lines extending in the direction perpendicular to the direction of the scanning lines, and a plurality of pixels arranged in a matrix delimited by the data lines and the scanning lines; each of the pixels being provided with a thin film luminescent device having a lead control circuit containing a thin film transistor for supplying a scanning signal to a gate electrode through one of the scanning lines, a pixel electrode, an organic semiconductive film deposited above the pixel electrode, and an opposite electrode deposited above the organic semiconductive film; the thin film luminescent device emitting light based on an image signal supplied from the data line through the lead control circuit; wherein

the region for forming the organic semiconductive film is divided by an insulating film which is thicker than the organic semiconductive film; and

the insulating film comprises a lower insulating layer composed of an inorganic material, and an upper insulating layer, composed of an inorganic material, so as to have a width which is narrower than that of the lower insulating layer.

[Claim 4] An active matrix display device according to any one of claims 1 to 3, wherein the lead control circuit is provided with a first TFT for supplying the scanning signal to the gate electrode and a second TFT of which the gate electrode is connected to the data line through the first TFT; and

the second TFT and the thin film luminescent device are connected in series between a common feed line formed in addition to the data line and the scanning line for supplying a drive current and the opposite electrode.

[Claim 5] An active matrix display device according to any one of claims 1 to 4, wherein the insulating film is used as a bank layer which prevents bleeding of a discharged solution when the luminescent thin film is formed by an ink-jet process in a region delimited by the insulating film.

[Claim 6] An active matrix display device according to claim 5, wherein the insulating film has a thickness of 1 μm or more.

[Claim 7] An active matrix display device according to any one of claims 1 to 6, wherein a region overlapping the

area for forming the lead control circuit in the region for forming the pixel electrode is covered with at least the lower insulating layer of the insulating film.

[Claim 8] An active matrix display device according to any one of claims 1 to 7, wherein in the regions delimited by the insulating film, corners of at least the lower insulating layer of the insulating film is rounded.

[Claim 9] An active matrix display device according to any one of claims 1 to 4, wherein the lower insulating layer of the insulating film is formed so as to cover the area for forming the lead control circuit in the region for forming the pixel electrode, the data line, the common feed line, and the scanning line, whereas the upper insulating layer is formed so as to form a striped pattern along the data line; and

the organic semiconductive film is formed in the region delimited by the striped pattern of the upper insulating layer.

[Claim 10] An active matrix display device according to claim 9, wherein the section in which the lower insulating layer overlaps the upper insulating layer is used as a bank layer for preventing bleeding of a discharged solution when the luminescent thin film is formed by an ink-jet process.

[Claim 11] An active matrix display device according to claim 10, wherein the overlapping section of the lower

insulating layer and the upper insulating layer has a thickness of 1 μm or more.

[Detailed Description of the Invention]

[0001]

[Industrial Field of the Invention]

The present invention relates to active matrix display devices which control thin film luminescent devices, such as electroluminescent (EL) devices emitting light by a driving current flowing in an organic semiconductive film, and light-emitting diode (LED) devices using thin film transistors (hereinafter referred to as TFTs).

[0002]

[Description of the Related Art]

Active matrix display devices using current-control-type luminescent devices; such as EL devices or LED devices have been proposed. Since luminescent devices used in such types of display devices have self-luminescent functions; these have advantages, such as no installation of a backlight being necessary, whereas backlights are essential for liquid crystal display devices, and a wider viewing angle.

[0003]

Fig. 7 is a block diagram of an active matrix display device using charge-injection-type organic EL devices. In the active matrix display device 1A shown in the drawing, a

plurality of scanning lines **gate**, a plurality of data lines **sig** extending in the direction perpendicular to the direction of the scanning lines **gate**, a plurality of common feed lines **com** along the data lines **sig**, and a plurality of pixels 7 in a matrix formed by the data lines **sig** and the scanning lines **gate** are formed on a transparent substrate 10. A data line driving circuit 3 and a scanning line driving circuit 4 are provided for the data lines **sig** and the scanning lines **gate**, respectively. Each pixel 7 is provided with a lead control circuit 50 for supplying scanning signals from a scanning line **gate**, and a thin film luminescent device 40 emitting based on image signals supplied from a data line **sig** through the lead control circuit 50. In this example, the lead control circuit 50 has a first TFT 20 for supplying scanning signals from the scanning line **gate** to a gate electrode; a holding capacitor **cap** for holding image signals supplied from the data line **sig** through the first TFT 20; and a second TFT 30 for supplying the image signals held in the holding capacitor cap to the gate electrode. The second TFT 30 and the thin film luminescent-device 40 are connected in series between an opposite electrode **op** (described below) and a common feed line **com**. The thin film luminescent device 40 emits light by a driving current from the common feed line **com** when the second TFT 30 is an ON mode, and this emitting mode is

maintained by a holding capacitor **cap** for a predetermined time.

[0004]

In such a configuration of active matrix display device 1A, as shown in Figs. 8, 9(A), and 9(B), the first TFT 20 and the second TFT 30 are formed of islands of a semiconductive film in each pixel 7. The first TFT 20 is provided with a gate electrode 21 as a part of a scanning line **gate**. In the first TFT 20, one source-drain region is electrically connected to a data line **sig** through a contact hole in a first insulating interlayer 51, and the other region is connected to a drain electrode 22. The drain electrode 22 extends towards the region of the second TFT 30, and this extension is electrically connected to a gate electrode 31 of the second TFT 30 through a contact hole in the first insulating interlayer 51. One source-drain region of the second TFT 30 is electrically connected to a relay electrode 35 through a contact hole of the first insulating interlayer 51, and the relay electrode 35 is electrically connected to a pixel electrode 41 of the thin film luminescent device 40 through a contact hole in a second insulating interlayer 52.

[0005]

Each pixel electrode 41 is independently formed in each pixel 7, as shown in Figs. 8, 9(B), and 9(C). An organic

semiconductive film 43 as a luminescent thin film and an opposite electrode **op** are formed above the pixel electrode 41 in that order. Although the organic semiconductive film 43 is formed in each pixel 7, a stripe film may be formed over a plurality of pixels 7. The opposite electrode **op** is formed not only in a display section 11 including pixels 7, but also over the entire surface of the transparent substrate 10.

[0006]

With reference to Figs. 8 and 9(A) again, the other source-drain region of the second TFT 30 is electrically connected to the common feed line **com** through a contact hole in the first insulating interlayer 51. An extension 39 of the common feed line **com** faces an extension 36 of the gate electrode 31 in the second TFT 30 separated by the first insulating interlayer 51 as a dielectric film to form a holding capacitor **cap**.

[0007]

[Problems to be Solved by the Invention]

In the active matrix display device 1A, however, only the second insulating interlayer 52 is disposed between the opposite electrode **op** facing the pixel electrode 41 and the data line **sig** on the same transparent substrate 10, unlike liquid crystal active matrix display devices; hence, a large capacitance is formed in the data line **sig** and the data line

driving circuit 3 is heavily loaded.

[0008]

Accordingly, as shown in Figs. 7, 8, 10(A), 10(B), and 10(C), the present inventors propose a reduction in parasitic capacitance in the data line **sig** by providing a thick insulating film (a bank layer **bank**; the region shaded with lines slanting downward to the left at a wide pitch) between the opposite electrode **op** and the data line **sig.** Furthermore, the present inventors propose that the region for forming the organic semiconductive film 43 be surrounded with the insulating film (bank layer **bank**) to stop a solution discharged from an ink-jet head and to prevent bleeding of the solution towards sides in the formation of the organic semiconductive film 43.

[0009]

When the entire bank layer **bank** is formed of a thick inorganic material in adoption of such a configuration, a problem of a prolonged film forming time arises. When the thick inorganic film is patterned, the pixel electrode 41 may be damaged due to overetching. On the other hand, when the bank layer **bank** is formed of an organic material, such as a resist, the organic semiconductive film 43 may deteriorate at the boundary between the organic semiconductive film 43 and the bank layer **bank** by the effects of the solvent components contained in the organic

material in the bank layer **bank.**

[0010]

Accordingly, it is an object of the present invention in view of the above problems to provide an active matrix display device, without damage of thin film luminescent devices, having a thick insulating film satisfactorily formed around an organic semiconductive film in the thin film luminescent devices.

[0011]

[Means for Solving the Problem]

The present invention for solving the above-mentioned problems is characterized by an active matrix display device comprising a display region including a plurality of scanning lines on a substrate, a plurality of data lines extending in the direction perpendicular to the direction of the scanning lines, and a plurality of pixels arranged in a matrix delimited by the data lines and the scanning lines; each of the pixels being provided with a thin film luminescent device having a lead control circuit containing a thin film transistor for supplying a scanning signal to a gate electrode through one of the scanning lines, a pixel electrode, an organic semiconductive film deposited above the pixel electrode, and an opposite electrode deposited above the organic semiconductive film; the thin film luminescent device emitting light based on an image signal

supplied from the data line through the lead control circuit; wherein the region for forming the organic semiconductive film is divided by an insulating film which is thicker than the organic semiconductive film; and the insulating film comprises a lower insulating layer which is formed of an inorganic material and is thicker than the organic semiconductive film, and an upper insulating layer which is deposited on the lower insulating layer and is formed of an organic material.

[0012]

In the present invention, the data line will form large parasitic capacitance if the opposite electrode is formed on the entire surface of the display section to face the data line; however, a thick insulating film is provided between the data line and the opposite electrode in the present invention to prevent formation of the parasitic capacitance in the data line. As a result, a load on the data line driving circuit is reduced, and low energy consumption and high-speed display operation are achieved. If the thick insulating film is formed of only an inorganic material, a long film deposition time is required, resulting in low productivity. In the present invention, only the lower insulating layer in contact with the organic semiconductive film of the thin film luminescent device is formed of an inorganic material, and an upper insulating layer composed

of an organic material such as a resist is formed thereon. Since the upper insulating layer composed of an organic material facilitates formation of a thick film, resulting in improved productivity. The upper insulating layer does not come into contact with the organic semiconductive film, but the lower insulating layer composed of an inorganic material does come into contact with the organic semiconductive film; hence, the organic semiconductive film is protected from deterioration affected by the upper insulating layer. Accordingly, the thin film luminescent device does not cause decreased luminescent efficiency or reliability.

[0013]

It is preferable in the present invention that the upper insulating layer be deposited in an inner region of the lower insulating layer so as to have a width narrower than that of the upper insulating layer. Such a two-step configuration prevents contact of the upper insulating layer composed of an organic material with the organic semiconductive film; hence deterioration of the organic semiconductive film can be more securely prevented.

[0014]

In such a two-step configuration, both the lower insulating layer and the upper insulating layer may be formed of inorganic materials. Another aspect of the present invention is an active matrix display device

comprising a display region including a plurality of scanning lines on a substrate, a plurality of data lines extending in the direction perpendicular to the direction of the scanning lines, and a plurality of pixels arranged in a matrix delimited by the data lines and the scanning lines; each of the pixels being provided with a thin film luminescent device having a lead control circuit containing a thin film transistor for supplying a scanning signal to a gate electrode through one of the scanning lines, a pixel electrode, an organic semiconductive film deposited above the pixel electrode, and an opposite electrode deposited above the organic semiconductive film; the thin film luminescent device emitting light based on an image signal supplied from the data line through the lead control circuit; wherein the region for forming the organic semiconductive film is divided by an insulating film which is thicker than the organic semiconductive film; and the insulating film comprises a lower insulating layer composed of an inorganic material, and an upper insulating layer, composed of an inorganic material, so as to have a width which is narrower than that of the lower insulating layer.

[0015]

In such a configuration, after films composed of inorganic materials, constituting a lower insulating layer and an upper insulating layer, are formed, the upper

insulating layer is patterned. Since the lower insulating layer functions as an etching stopper, the pixel electrodes will not be damaged by slight overetching. After the patterning, the lower insulating layer is patterned. Since only one layer of the lower insulating layer is etched, the etching is readily controlled so that overetching, which would damage the pixel electrodes, does not occur.

[0016]

It is preferable in the present invention that the lead control circuit be provided with a first TFT for supplying the scanning signal to the gate electrode and a second TFT of which the gate electrode is connected to the data line through the first TFT, and that the second TFT and the thin film luminescent device be connected in series between a common feed line formed in addition to the data line and the scanning line for supplying a drive current and the opposite electrode. Although the lead control circuit can be composed of a TFT and a holding capacitor, the lead control circuit of each pixel is preferably composed of two TFTs and two holding capacitors for improving display quality.

[0017]

It is preferable in the present invention that the insulating film be used as a bank layer which prevents bleeding of a discharged solution when the organic semiconductive film is formed by an ink-jet process in a

region delimited by the insulating film. The insulating film preferably has a thickness of 1 μm or more.

[0018]

It is preferable in the present invention that a region overlapping the area for forming the lead control circuit in the region for forming the pixel electrode be covered with at least the insulating film. That is, it is preferable that among the region for forming the pixel electrode, the thick insulating film be opened only at the flat section not having the lead control circuit and the luminescent thin film be formed only at the interior thereof. Such a configuration can prevent display irregularities due to an irregular thickness of the luminescent thin film. A thinner section of the luminescent thin film causes a concentration of the driving current of the thin film luminescent device and decreased reliability; however, this configuration can prevent such a problem. If the organic semiconductive film emits light due to a driving current between a pixel electrode and the opposite electrode in the region overlapping the lead control circuit, the light is shaded by the lead control circuit and does not contribute to display. The driving current not contributing to display by the shading effect of the lead control circuit is an unavailable current. In the present invention, the thick insulating film is formed at the section, in which such an unavailable

current is expected, to prevent formation of the unavailable current. As a result, a current in the common feed line can be reduced. Thus, by reducing the width of the common feed line, a luminescent area can be increased, improving display characteristics, such as luminance and contrast.

[0019]

In the present invention, in the regions delimited by the insulating film, corners of at least the lower insulating layer of the insulating film may be rounded so that the organic semiconductive film has a rounded planar shape. The organic semiconductive film having such a shape avoids the concentration of the driving current at the corners, hence defects, such as insufficient voltage resistance, can be prevented at the corners.

[0020]

When the organic semiconductive film having a striped pattern is formed, the lower insulating layer of the insulating film is formed so as to cover the area for forming the lead control circuit in the region for forming the pixel electrode, the data line, the common feed line, and the scanning line, whereas the upper insulating layer is formed so as to form a striped pattern along the data line, and the organic semiconductive film is formed in the region delimited by the striped pattern of the upper insulating layer by, for example, an ink-jet process.

[0021]

In such a configuration, the lead control circuit is covered with the lower insulating layer so that only the luminescent thin formed at the flat section of the pixel electrode contributes to luminescence. That is, the thin film luminescent device is formed only at the flat section of the pixel electrode. Thus, the resulting luminescent thin film has a constant thickness and does not display irregularities. Since the lower insulating layer prevents a driving current in the section not contributing to display, an unavailable current in the common feed line can be prevented. In such a configuration, the section in which the lower insulating layer overlaps the upper insulating layer can be used as a bank layer for preventing bleeding of a discharged solution when the luminescent thin film is formed by an ink-jet process. When the insulating film is used as a bank layer, the overlapping section of the lower insulating layer and the upper insulating layer preferably has a thickness of 1 μm or more.

[0022]

[Description of the Embodiments]

Embodiments of the present invention will now be described with reference to the drawings. Parts having the same functions as in Figs. 7 and 10 are referred to the same numerals.

[0023]

[First Embodiment]

(Overall Configuration)

Fig. 1 is a schematic block diagram of an overall layout of an active matrix display device in accordance with the present invention. Fig. 2 is a plan view of a pixel extracted included therein. Figs. 3(A), 3(B) and 3(C) are cross-sectional views taken from line A-A', B-B', and C-C', respectively, in Fig. 2.

[0024]

In the active matrix display device 1 shown in Fig. 1, the central portion of a transparent substrate 10 as a base is used as a display section 11. Among the peripheral section of the transparent substrate 10, a data line driving circuit 3 for outputting image signals is provided on the ends of data lines **sig**, whereas a scanning line driving circuit 4 for outputting scanning signals is provided on the ends of scanning lines **gate**. In these driving circuits 3 and 4, an n-TFT and a p-TFT form a complementary TFT, and many complementary TFTs form a shift resistor circuit, a level shifter circuit, and an analog switch circuit. In the display section 11, like in an active matrix substrate of an active matrix liquid crystal display device, a plurality of scanning lines **gate**, a plurality of data lines **sig** extending perpendicular to the extending direction of the scanning

lines **gate**, and a plurality of pixels 7 formed in a matrix by the data lines **sig** and the scanning lines **gate** are provided on the transparent substrate 10.

[0025]

Each pixel 7 is provided with a lead control circuit 50 for supplying scanning signals through a scanning line **gate**, and a thin film luminescent device 40 emitting light on the basis of image signals supplied from a data line **sig** through the lead control circuit 50. In this embodiment, the lead control circuit 50 includes a first TFT 20 for supplying a scanning signal to a gate electrode through a scanning line **gate**, s holding capacitor **cap** for holding an image signal supplied from a data line **sig** through the first TFT 20, and a second TFT 30 for supplying the image signal held in the holding capacitor **cap** to the gate electrode. The second TFT 30 and the thin film luminescent device 40 are connected in series between an opposite electrode **op** and a common feed line **com**.

[0026]

As shown in Figs. 2, 3(A), and 3(B), in each pixel of the active matrix display device 1 having such a configuration, the first TFT 20 and the second TFT 30 are formed using islands of semiconductive films (silicon films).

[0027]

In the first TFT 20, a gate electrode 21 is formed as a

part of the scanning line **gate**. In the first TFT 20, one of the **source** and drain regions is electrically connected to the data line **sig** via a contact hole in a first insulating film 51, whereas the other is electrically connected to a drain electrode 22. The drain electrode 22 extends towards the region of the second TFT 30, and the extended section is electrically connected to a gate electrode 31 of the second TFT 30 via a contact hole in the first insulating film 51.

[0028]

One of the source and drain regions of the second TFT 30 is electrically connected to a relay electrode 35 simultaneously formed with the data line **sig** via a contact hole in the first insulating film 51, and the relay electrode 35 is electrically connected to a transparent pixel electrode 41 composed of an ITO film in the thin film luminescent device 40 via a contact hole in a second insulating film 52.

[0029]

As shown in Figs. 2, 3(B), and 3(C), pixel electrodes 41 are independently formed in individual pixels 7. An organic semiconductive film 43 composed of polyphenylene vinylene (PVV) or the like and an opposite electrode **op** composed of a metal film such as lithium-containing aluminum or calcium are deposited above each pixel electrode 41, in that order, to form a thin film luminescent device 40.

Although an organic semiconductive film 43 is formed on each pixel in this embodiment, a stripe organic semiconductive film 43 will be formed over a plurality of pixels 7 in some cases, as will be described below. The opposite electrode **op** is formed over the entire display section 11, other than the periphery of the region in which terminals 12 are formed. The terminals 12 include a terminal electrically connected to the opposite electrode **op** formed using a lead (not shown in the drawing) which is simultaneously formed with the opposite electrode **op**.

[0030]

The configuration of the thin film luminescent device 40 may be a configuration provided with a positive hole injection layer having an increased luminescent efficiency (hole injection efficiency), or a configuration provided with a positive hole injection layer and an electron injection layer.

[0031]

With reference to Figs. 2 and 3(A) again, the other of the source and drain regions of the second TFT 30 is electrically connected to the common feed line **com** via a contact hole of the first insulating film 51. The extension 39 of the common feed line **com** faces the extension 36 of the gate electrode 31 separated by the first insulating film 51 as a dielectric film to form a holding capacitor **cap**. In

place of the common feed line **com**, a capacitor line formed parallel to the scanning line **gate** may be used for the formation of the holding capacitor **cap**. Alternatively, the holding capacitor **cap** may be formed of the drain region of the first TFT 20 and the gate electrode 31 of the second TFT 30.

[0032]

In such an active matrix display device 1, when the first TFT 20 turns on by selection of a scanning signal, an image signal from the data line **sig** is applied to the gate electrode 31 of the second TFT 30 via the first TFT 20 and simultaneously stored in the holding capacitor **cap** via the first TFT 20. When the second TFT 30 turns on, a voltage is applied between the opposite electrode **op** as a negative electrode and the pixel electrode 41 as a positive electrode. When the voltage exceeds the threshold voltage, a current (a driving current) flowing in the organic semiconductive film 43 steeply increases. Thus, the luminescent device 40 emits light as an electroluminescent device or an LED device. Light from the luminescent device 40 is reflected by the opposite electrode **op**, passes through the transparent pixel electrode 41, and emerges from the transparent substrate 10. Since the driving current for performing such luminescence flows in a current passage including the opposite electrode **op**, the organic semiconductive film 43, the pixel electrode

41, the second TFT 30, and the common feed line **com**, the current stops when the second TFT 30 turns off. The holding capacitor **cap**, however, holds the gate electrode of the second TFT 30 at a potential corresponding to the image signal; hence, the second TFT 30 still turns on. Thus, a driving current continues to flow in the luminescent device 40 so that the pixel maintains a turned-on state. This state is held until the second TFT 30 turns off by accumulation of the next image data in the holding capacitor **cap**.

[0033]

(Bank Layer Configuration)

In order to prevent formation of a large parasitic capacitance in the data line **sig** in such an active matrix display device 1 in this embodiment, as shown in Figs. 1, 2, 3(A), 3(B), and 3(C), an insulating film (a bank layer **bank**, the region shaded with lines slanting downward to the left or double slanting lines at a wide pitch) which is thicker than the organic semiconductive film 41 is provided along the data line **sig** and the scanning line **gate**, and the opposite electrode **op** is formed above the bank layer **bank**. Since the second insulating film 52 and the thick bank layer **bank** are disposed between the data line **sig** and the opposite electrode **op**, the parasitic capacitance formed in the data line **sig** is significantly reduced. Thus, the load on the

driving circuits 3 and 4 can be reduced, resulting in lower electrical power consumption and improved display operation.

[0034]

The bank layer **bank** consists of a lower insulating layer 61 which is formed of an inorganic material such as a silicon oxide film or a silicon nitride film and is thicker than the organic semiconductive film 41, and an upper insulating layer 62 which is formed on the lower insulating layer 61 and is composed of an organic material such as a resist or a polyimide film. For example, the thicknesses of the organic semiconductive film 41, the lower insulating layer 61, and the upper insulating layer 62 are in ranges of 0.05 μm to 0.2 μm, 0.2 μm to 1.0 μm, and 1 μm to 2 μm, respectively.

[0035]

In such a double-layer configuration, the upper insulating layer 62 is formed of a resist or a polyimide film which facilitates formation of a thick film; hence, only the lower insulating layer 61 can be formed of an inorganic material. Since the entire bank layer **bank** is not formed of an inorganic material, the formation of the inorganic film by, for example, a PECVD process does not require a long time. Thus, productivity of the active matrix display device 1 is increased.

[0036]

Also, in such a double-layer configuration, the organic semiconductive film 41 comes into contact with the inorganic lower insulating layer 61, but not with the organic upper insulating layer 62. The organic semiconductive film 41 is, therefore, not damaged by the effects of the organic upper insulating layer 62, and the thin film luminescent device 40 does not decreased luminescent efficiency nor decreased reliability.

[0037]

As shown in Fig. 1, the bank layer **bank** is also formed in the peripheral region of the transparent substrate 10 (the exterior region of the display section 11); hence the data line driving circuit 3 and the scanning line driving circuit 4 are covered with the bank layer **bank**. The opposite electrode **op** must be formed at least in the display section 11, but is unnecessary in the driving circuit region. Since the opposite electrode **op** is generally formed by a mask sputtering process, an inaccurate alignment such as overlap of the opposite electrode **op** and the driving circuits may occur. In this embodiment, however, the bank layer **bank** is disposed between the lead layer of the driving circuits and the opposite electrode **op**; hence formation of parasitic capacitance in the driving circuits 3 and 4 is prevented even if the opposite electrode **op** overlaps the driving circuits. As a result, the load on the driving

circuits 3 and 4 is reduced, consumption of electrical power is reduced, and high-speed display operation is achieved.

[0038]

In this embodiment, the bank layer **bank** is also formed in the area, which overlaps the relay electrode 35 of the lead control circuit 50, in the region for forming the pixel electrode 41. The organic semiconductive film 43 is, therefore, not formed in the area overlapping the relay electrode 35. Since the organic semiconductive film 43 is formed only at the flat section in the region for forming the pixel electrode 41, the resulting organic semiconductive film 43 has a constant thickness so that irregularities of display do not occur. If the organic semiconductive film 43 has a part having a lesser thickness, the driving current for the thin film luminescent device 40 is concentrated therein, resulting in decreased reliability of the thin film luminescent device 40. The uniform thickness in this embodiment does not cause such a problem. If the bank layer **bank** is not provided in the region overlapping the relay electrode 35, the organic semiconductive film 43 emits light by a driving current between the relay electrode 35 and the opposite electrode **op**; however, the relay electrode 35 and the opposite electrode **op** inhibit emission of the light to the exterior, and the light does not contribute to display. The driving current flowing in the section which does not

contribute to display is an unavailable current in view of the display. In this embodiment, the bank layer **bank** is formed at the position in which an unavailable current will flow so as to prevent an unavailable current flowing in the common feed line **com**. Thus, the width of the common feed line **com** can be reduced. As a result, the luminescent area, which contributes to improved display performance, such as luminance and contrast, can be increased.

[0039]

When the bank layer **bank** is formed of a black resist, the bank layer **bank** functions as a black matrix which improves the quality of display, such as contrast. In the active matrix display device 1 of this embodiment, the opposite electrode **op** is formed on the entire pixel 7 at the front face of the transparent substrate 10; hence light reflected by the opposite electrode **op** causes decreased contrast. When the bank layer **bank** for preventing the formation of the parasitic capacitance is formed of a black resist, the bank layer **bank** also functions as a black matrix which shades the light reflected by the opposite electrode **op** and contributes to high contrast.

[0040]

(Method for Making Active Matrix Display Device)

Since the resulting bank layer **bank** surrounds the region for forming the organic semiconductive film 43, the

layer can prevent bleeding of a discharged solution outside when the organic semiconductive film 43 is formed by discharging a liquid material (discharging solution) through an ink-jet head in the production process of the active matrix display device. In the following method for making the active matrix display device 1, the steps for making the first TFT 20 and the second TFT 30 on the transparent substrate 10 are substantially the same as the steps for making the active matrix substrate of the active matrix liquid crystal display device; hence only the outline thereof will be briefly described with reference to Figs. 3(A), 3(B), and 3(C).

[0041]

First, an underlying protective film (not shown in the drawing) composed of a silicon oxide film with a thickness of approximately 2,000 to 5,000 angstroms is formed, if necessary, on a transparent substrate 10 by a plasma enhanced CVD using tetraethoxysilane (TEOS) and gaseous oxygen as material gases. A semiconductive film composed of an amorphous silicon film with a thickness of approximately 300 to 700 angstroms is formed on the underlying protective film by a plasma enhanced CVD. The amorphous silicon semiconductive film is subjected to a crystallization step, such as a laser annealing step or a solid phase deposition step so that the semiconductive film is crystallized to form

a polysilicon film.

[0042]

The semiconductive film is patterned to form islands of semiconductive films, and then a gate insulating film 57 composed of a silicon oxide or silicon nitride film with a thickness of approximately 600 to 1,500 angstroms is formed thereon by a plasma enhanced CVD using tetraethoxysilane (TEOS), gaseous oxygen and the like as material gases.

[0043]

Next, a conductive film composed of a metal film, such as aluminum, tantalum, molybdenum, titanium, or tungsten, is formed by a sputtering process, and is patterned to form gate electrodes 21 and 31 and an extension 36 of the gate electrode 31 (a gate electrode forming step). This step also forms a scanning line **gate**.

[0044]

In such a state, a high concentration of phosphorus ions are implanted to source and drain regions by self-alignment with respect to the gate electrodes 21 and 31. The section which is not doped with the impurity functions as a channel region.

[0045]

After forming a first insulating interlayer 51 and then forming contact holes, a data line **sig**, a drain electrode 22, a common feed line **com**, an extension 39 of the common feed

line **com**, and a relay electrode 35 are formed. As a result, a first TFT 20, a second TFT 30, and a holding capacitor **cap** are formed.

[0046]

Next, a second insulating interlayer 52 is formed and a contact hole is formed at the position corresponding to the relay electrode 35 of the insulating interlayer. An ITO film is formed on the entire second insulating interlayer 52 and is patterned, and then a pixel electrode 41 which is electrically connected to the source and drain regions of the second TFT 30 via the contact hole is formed in each pixel 7.

[0047]

An inorganic film (for forming a lower insulating layer 61) is formed on the front face of the second insulating film 52 by a PECVD process, and then a resist (upper insulating layer 62) is formed along the scanning line **gate** and the data line **sig**. The inorganic film is patterned through the resist as a mask. As a result, a double-layered bank layer **bank** including the lower insulating layer 61 and the upper insulating layer 62 is formed. In this step, the resist section remaining along the data line **sig** has a large width so as to cover the common feed line **com**. Thus, a region for forming the organic semiconductive film 43 in the luminescent device 40 is surrounded with the bank layer **bank**.

[0048]

Organic semiconductive films 43 corresponding to R, G, and B are formed in regions in a matrix delimited by the bank layer **bank** by an ink-jet process. A liquid material (a precursor or a discharging solution) for forming the organic semiconductive film 43 is discharged in the inner region of the bank layer **bank** through an ink-jet head and fixed in the inner region of the bank layer **bank** to form the organic semiconductive film 43. Since the upper insulating layer 62 of the bank layer **bank** is composed of a resist or a polyimide film, it has water-repellent properties. In contrast, the precursor of the organic semiconductive film 43 contains a hydrophilic solution; hence, the region for forming the organic semiconductive film 43 is surely defined by the bank layer **bank**. Since the solution does not bleed out of the adjacent pixels 7, the organic semiconductive film 43 can be formed only in the predetermined region.

[0049]

In this step, since the precursor discharged from the ink-jet head forms a convex surface with a thickness of approximately 2 μm to 4 μm by the surface tension, the bank layer must have a thickness of approximately 1 μm to 3 μm. Although the precursor discharged from the ink-jet head comes into contact with the upper insulating layer 62 in this state, the solvent in the precursor is removed by heat

treatment at 100°C to 150°C. Thus, the thickness of the organic semiconductive film 43 fixed in the inner region of the bank layer **bank** is in a range of approximately 0.05 μm to 0.2 μm. The organic semiconductive film 43 no longer is in contact with the upper insulating layer 62.

[0050]

When the bank layer **bank** has a height of 1 μm or more, the bank layer **bank** sufficiently functions as a barrier even if the bank layer **bank** does not have water-repellent properties. Such a thick bank layer **bank** can define the region for forming the organic semiconductive film 43 when the film is formed by a coating process in place of the ink-jet process.

[0051]

Next, an opposite electrode **op** is formed on substantially the entire transparent substrate 10.

[0052]

According to the method, organic semiconductive films 43 can be formed at predetermined positions corresponding to R, G, and B by an ink-jet process; hence a full color active matrix display device 1 can be made with high productivity.

[0053]

Although TFTs are also formed in the data line driving circuit 3 and the scanning line driving circuit 4 shown in Fig. 1, these TFTs can be formed by completely or partly

employing the above steps for forming the TFT in the pixel 7. Thus, the TFTs in the driving circuits are also formed in the same interlayer in which TFTs for pixels 7 are formed. In combinations for the first TFT 20 and the second TFT 30, combinations of an n-type and an n-type, of a p-type and a p-type, and of an n-type and a p-type are allowable. Since all the combinations of TFTs can be produced by any well-known method, description thereof will be omitted.

[0054]

[Second Embodiment]

Figs. 4(A), 4(B) and 4(C) are cross-sectional views of an active matrix display device in accordance with this embodiment at positions corresponding to line A-A', B-B', and C-C', respectively, in Fig. 2. This embodiment has a basic configuration which is substantially the same as that of the first embodiment; hence, the same symbols are assigned for the same parts, without detailed description thereof. Since the region for forming the bank layer **bank** in the active matrix display device of this embodiment is the same as that in the first embodiment, Figs. 1 and 2 are also referred to in the following description.

[0055]

In order to prevent formation of a large parasitic capacitance in a data line **sig**, also, in this embodiment, as shown in Figs. 1, 2, 4(A), 4(B), and 4(C), an insulating

film (a bank layer **bank**, the region shaded with lines slanting downward to the left or double slanting lines at a wide pitch) which is thicker than an organic semiconductive film 41 is provided along the data line **sig** and a scanning line **gate**, and an opposite electrode **op** is formed above the bank layer **bank**.

[0056]

As in the first embodiment, the bank layer **bank** consists of an inorganic lower insulating layer 61 such as a silicon oxide or silicon nitride film which is thicker than the organic semiconductive film 41, and an upper organic insulating film 62 such as a resist or a polyimide film formed on the lower insulating layer 61.

[0057]

In this embodiment, as shown in Figs. 4(A), 4(B) and 4(C), the upper organic insulating film 61 has a smaller width than that of the lower inorganic insulating film 61 and is formed on the inner region of the lower insulating layer 61. For example, the overlapping width of the upper insulating layer 61 and the pixel electrode 41 is in a range of 1 μm to 3 μm, and a gap between an edge of the lower insulating layer 61 and the corresponding edge of the upper insulating layer 62 is in a range of 1 μm to 5 μm. Thus, the bank layer **bank** has a double-layered configuration in which the underlying insulating film 61 and the upper

insulating layer 62 having different widths are deposited. The upper insulating layer 62 is formed of a resist or a polyimide film, which facilitates formation of a thick film, in such a double-layered configuration, and only the lower insulating layer 61 is composed of an inorganic material. The process, such as a PECVD process, for forming the inorganic film does not require a long deposition time, unlike the process for forming a thick bank layer **bank** which is entirely composed of an inorganic material. Thus, the active matrix display device 1 can be manufactured with high productivity. In such a double-layered configuration, the organic semiconductive film 41 comes into contact with the lower insulating layer 61, but not with the upper insulating layer 62. Furthermore, the upper insulating layer 62 is formed on the inner portion of the lower insulating layer 61 to avoid the contact of the organic semiconductive film 43 with the upper insulating layer 62. Thus, the upper organic insulating film 62 does not cause deterioration of the organic semiconductive film 41 which would result in decreased luminescent efficiency and decreased reliability of the thin film luminescent device 40.

[0058]

The other configurations are the same as those in the first embodiment. Each pixel 7 is surrounded with the bank layer **bank**. Organic semiconductive films 43 can be formed

in predetermined positions corresponding to R, G, and B by an ink-jet process; hence, a full color active matrix display device 1 can be manufactured with high productivity, as in the first embodiment.

[0059]

In the formation of the bank layer **bank** having such a configuration, an inorganic film (for forming a lower insulating layer 61) is formed on the front face of the second insulating film 52 by a PECV process, the lower insulating layer 61 is formed along the scanning line **gate** and the data line **sig**, and then a resist used for the patterning is removed. Next, a resist or a polyimide film with a thickness which is smaller than that of the lower insulating layer 61 is formed thereon as the upper insulating layer 62.

[0060]

[Third Embodiment]

An active matrix display device 1 in this embodiment has the same configuration as that in the second embodiment, but a material for the bank layer **bank** is different. Thus, the same symbols are assigned for the same parts, without detailed description thereof. Figs. 1, 2, and 4 are also referred to in the following description, as in the second embodiment.

[0061]

In order to prevent formation of a large parasitic capacitance in a data line **sig**, as shown in Figs. 1, 2, 4(A), 4(B), and 4(C), an insulating film (a bank layer **bank**, the region shaded with lines slanting downward to the left or double slanting lines at a wide pitch) which is thicker than an organic semiconductive film 41 is provided along the data line **sig** and a scanning line **gate**, and an opposite electrode **op** is formed above the bank layer **bank**.

[0062]

The bank layer **bank** consists of an inorganic lower insulating layer 61 such as a silicon nitride film which is thicker than the organic semiconductive film 41, and an upper inorganic insulating film 62 such as a silicon oxide film formed on the lower insulating layer 61. Since the organic semiconductive film 43 does not come into contact with any other organic material in such a double-layered configuration, it will not be deteriorate by the effects of the other organic material. Thus, a decrease in luminescent efficiency and reliability does not occur in the thin film luminescent device 40.

[0063]

The upper organic insulating film 61 has a smaller width than that of the lower inorganic insulating film 61 and is formed on the inner region of the lower insulating layer 61. Thus, the bank layer **bank** has a double-layered

configuration in which the underlying insulating film 61 and the upper insulating layer 62 having different widths are deposited.

[0064]

In the formation of the bank layer **bank** having such a configuration, inorganic films (a silicon nitride film and a silicon oxide film) for forming the lower insulating layer 61 and the upper insulating layer 62 are formed in that order, and the upper insulating layer 62 is patterned. Since the lower insulating layer 61 functions as an etching stopper, slight overetching will not damage the pixel electrode 41. After the patterning, the lower insulating layer 61 is patterned. Since a single layer of the lower insulating layer 61 is etched, the etching is readily controlled and overetching which would damage the pixel electrode 41 does not occur.

[0065]

The other configurations are the same as those in the first and second embodiments. Each pixel 7 is, therefore, surrounded with the bank layer **bank**. Organic semiconductive films 43 can be formed in predetermined positions corresponding to R, G, and B by an ink-jet process; hence, a full color active matrix display device 1 can be manufactured with high productivity, as in the first embodiment.

[0066]

[Modifications of First, Second, and Third Embodiments]

Since the bank layer **bank** is formed along the data line **sig** and the scanning line **gate** in the above embodiments, the bank layer **bank** delimits pixels 7 in a matrix. The bank layer **bank** may be formed along only the data line **sig**. Organic semiconductive film 43 having a striped pattern, corresponding to R, G, and B, can be formed in striped regions delimited by the bank layer **bank** by an ink-jet process; hence a full color active matrix display device 1 can be made with high productivity.

[0067]

Although the corners delimited by the bank layer **bank** are edged in the above embodiments, it may be rounded so that the organic semiconductive film 43 has a rounded planar shape. The organic semiconductive film 43 having such a shape avoids the concentration of the driving current at the corners, hence defects, such as insufficient voltage resistance, can be prevented at the corners.

[0068]

[Fourth Embodiment]

An active matrix display device 1 in this embodiment has a basic configuration like that in the first, second or third embodiment; hence, Fig. 1 is referred to for the description, and the same symbols are assigned for the same

parts, without detailed description thereof.

[0069]

Fig. 5 is a plan view of a pixel taken from an active matrix display device of this embodiment. Figs. 6(A), 6(B) and 6(C) are cross-sectional views taken from line A-A', B-B', and C-C', respectively, in Fig. 5.

[0070]

As described below, a lower insulating layer 61 partly overlaps an upper insulating layer 62 in this embodiment so that these films have different functions. As shown in Fig. 1, also, in this embodiment, a plurality of scanning lines **gate**, a plurality of data lines **sig** extending perpendicular to the extending direction of the scanning lines **gate**, a plurality of common feed lines **com** formed parallel to the data lines **sig**, and a plurality of pixels 7 formed in a matrix by the data lines **sig** and the scanning lines **gate** are provided.

[0071]

In this embodiment, as shown in Figs. 5 and 6, a lower insulating layer 61 (a region shaded by double lines slanting down toward the left) is formed so as to cover an area overlapping the portion for forming a lead control circuit 50 in the region for forming a pixel electrode 41; the data line **sig**; the common feed line **com**; and the scanning line **gate**. On the other hand, the upper insulating

layer 62 (a region shaded by lines at a wide pitch and slanting down toward the left) is formed only on areas along the data lines **sig** in the region for forming the lower insulating layer 61 so as to form a striped pattern. Organic semiconductive films 43 are formed in the striped areas delimited by the upper insulating layer 62.

[0072]

When the organic semiconductive films 43 having the striped pattern are formed by an ink-jet process in such a configuration, the overlapping section of the lower insulating layer 61 and the upper insulating layer 62 is used as a bank layer **bank** to prevent bleeding of the discharged solution. In this embodiment, the overlapping section of the lower insulating layer 61 and the upper insulating layer 62 has a thickness of 1 μm or more.

[0073]

Since the second insulating film 52 and the thick bank layer **bank** (the lower insulating layer 61 and the upper insulating layer 62) are disposed between the data lines **sig** and the opposite electrode **op** in such a configuration, parasitic capacitance forming in the data line **sig** is significantly reduced. Thus, the load on the driving circuits 3 and 4 can be reduced, resulting in lower electrical power consumption and improved display operation.

[0074]

Although the striped organic semiconductive films 43 are formed, an area overlapping the portion for forming a lead control circuit 50 in the region for forming the pixel electrode 41, and a scanning line **gate** are covered with the upper insulating layer 62. Thus, organic semiconductive film 43 formed only on the flat section in the pixel electrode 41 contributes to luminescence. In other words, the thin film luminescent device 40 is formed only in the flat section of the pixel electrode 41. Thus, the organic semiconductive film 43 has a constant thickness and does not cause irregularities of display and concentration of a driving current. Since the lower insulating layer 61 inhibits a current flow in the section which does not contribute to display, an unavailable current does not flow in the common feed line **com**.

[0075]

When the underlying insulating film 61 is formed of an inorganic material such as a silicon oxide film or a silicon nitride film which is thicker than the organic semiconductive film 41 and when the upper insulating layer 62 is composed of an organic material such as a resist or a polyimide film, only the lower insulating layer 61 is composed of the inorganic material. Thus, the process, such as a PECVD process, for forming the inorganic film does not require a long deposition time, unlike the process for

forming a thick bank layer **bank** which is entirely composed of an inorganic material. Thus, the active matrix display device 1 can be manufactured with high productivity. In such a double-layered configuration, the organic semiconductive film 41 comes into contact with the lower insulating layer 61, but not with the upper organic insulating film 62. Thus, the upper organic insulating film 62 does not cause deterioration of the organic semiconductive film 41 which results in decreased luminescent efficiency and decreased reliability of the thin film luminescent device 40.

[0076]

When the lower insulating layer 61 is composed of an inorganic material such as a silicon nitride film which is thicker than the organic semiconductive film 41 and when the upper insulating layer 62 formed on the lower insulating layer 61 is composed of an inorganic material such as a silicon oxide film, the organic semiconductive film 43 does not come into contact with an organic material and thus is not deteriorated by the effects of the organic material. Thus, a decrease in the luminescent efficiency and reliability does not occur in the thin film luminescent device 40. Since the underlying insulating film 61 with a smaller width is deposited on the inner region of the lower insulating layer 61, the lower insulating layer 61 functions

as an etching stopper when the upper insulating layer 62 is patterned, as described in the third embodiment.

[0077]

[Advantages]

As described above, in the active matrix display device in accordance with the present invention, the insulating film which is formed so as to surround the region for forming the organic semiconductive film consists of a lower insulating layer which is composed of an inorganic material and is thicker than the organic semiconductive film, and an upper insulating layer which is formed thereon and is composed of an organic material. Since a thick insulating film is disposed between the data line and the opposite electrode, formation of parasitic capacitance in the data line can be prevented. Thus, the load on the data line driving circuit can be reduced, resulting in lower electrical power consumption and improved display operation. In the present invention, only the lower insulating layer in contact with the organic semiconductive film of the thin film luminescent device is formed of an inorganic material, and the upper insulating layer formed thereon is composed of an organic material which facilitates formation of a thick film. Thus, the process has high productivity. The upper insulating layer does not come into contact with the organic semiconductive film, but the lower insulating layer composed

of an inorganic material does come into contact with the organic semiconductive film; hence, the organic semiconductive film is protected from deterioration caused by the upper insulating layer. Accordingly, the thin film luminescent device does not cause decreased luminescent efficiency or reliability.

[0078]

When the upper insulating layer is deposited in an inner region of the lower insulating layer so as to have a width narrower than that of the upper insulating layer, contact of the upper insulating layer composed of an organic material with the organic semiconductive film is more securely prevented.

[0079]

In another embodiment of the present invention, the insulating film formed so as to surround the region for forming the organic semiconductive film consists of a lower insulating layer composed of an inorganic material and an upper insulating layer which is formed on an inner region of the lower insulating layer and has a smaller width than that of the lower insulating layer. Thus, the thick insulating film disposed between the data line and the opposite electrode can prevent formation of parasitic capacitance in the data line. Thus, the load on the data line driving circuit can be reduced, resulting in lower electrical power

consumption and improved display operation. When a lower inorganic insulating film and an upper inorganic film are formed and when the upper insulating layer is patterned, the lower insulating layer functions as an etching stopper. Thus, overetching which would damage the pixel electrode does not occur. After patterning of the upper insulating layer, only a single layer of the lower insulating layer is etched in the succeeding patterning. Thus, the etching is readily controlled and overetching which would damage the pixel electrode does not occur.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a schematic block diagram of an overall layout of an active matrix display device in accordance with a first embodiment of the present invention.

[Fig. 2]

Fig. 2 is a plan view of a pixel taken from the active matrix display device shown in Fig. 1.

[Fig. 3]

Figs. 3(A), 3(B) and 3(C) are cross-sectional views taken from line A-A', B-B', and C-C', respectively, in Fig. 2.

[Fig. 4]

Figs. 3(A), 3(B) and 3(C) are cross-sectional views taken from line A-A', B-B', and C-C', respectively, in Fig.

2.

[Fig. 5]

Fig. 5 is a plan view of a pixel taken from an active matrix display device in accordance with a fourth embodiment of the present invention.

[Fig. 6]

Figs. 6(A), 6(B) and 6(C) are cross-sectional views taken from line A-A', B-B', and C-C', respectively, in Fig. 5.

[Fig. 7]

Fig. 7 is a schematic block diagram of an overall layout of a conventional active matrix display device or an active matrix display device in accordance with a comparative embodiment of the present invention.

[Fig. 8]

Fig. 8 is a plan view of a pixel taken from the active matrix display device shown in Fig. 7.

[Fig. 9]

Figs. 9(A), 9(B) and 9(C) are cross-sectional views taken from line A-A', B-B', and C-C', respectively, in Fig. 8.

[Fig. 10]

Figs. 10(A), 10(B) and 10(C) are other cross-sectional views taken from line A-A', B-B', and C-C', respectively, in Fig. 8.

[Reference Numerals]

1	active matrix display device
2	display section
3	data line driving circuit
4	scanning line driving circuit
7	pixel
10	transparent substrate
12	terminal
20	first TFT
21	gate electrode of first TFT
30	second TFT
31	gate electrode of second TFT
40	luminescent device
41	pixel electrode
43	organic semiconductive material
61	lower insulating layer
62	upper insulating layer
bank	bank layer (insulating film)
cap	holding capacitor
com	common feed line
gate	scanning line
op	opposite electrode
off	discontinuity of bank layer
sig	data line

[Name of Document] Drawings

Fig. 1

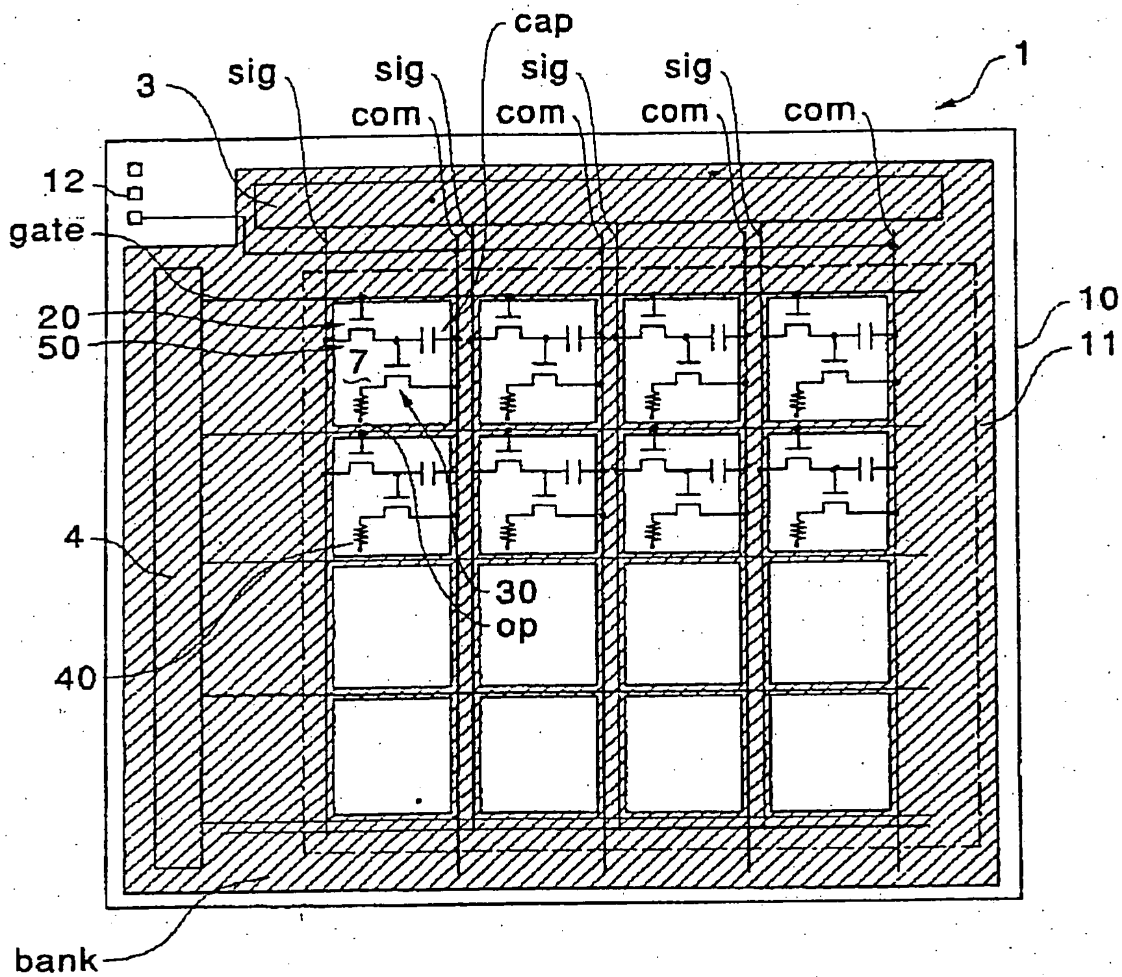


Fig. 2

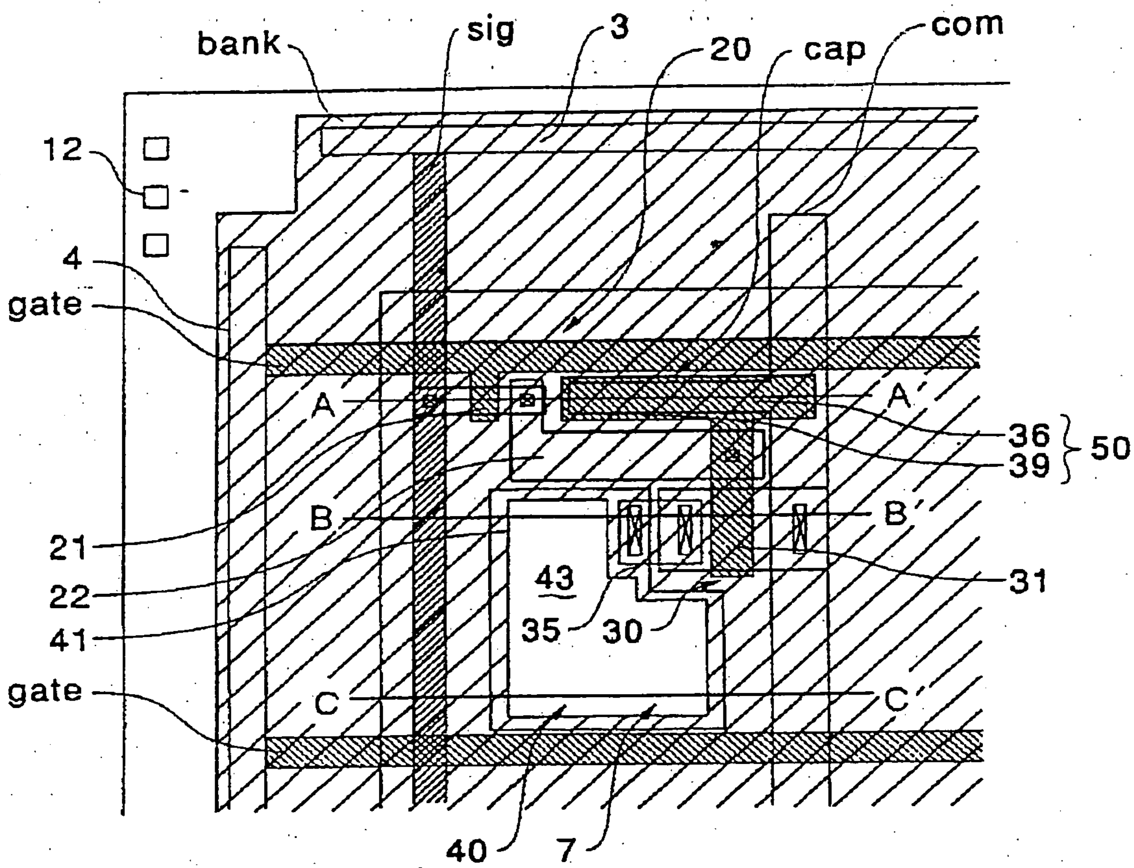

bank
sig
3
20
cap
com
12
4
gate
A
A'
36
39
50
B
B'
21
22
41
43
35
30
31
gate
C
C'
40
7

Fig. 3

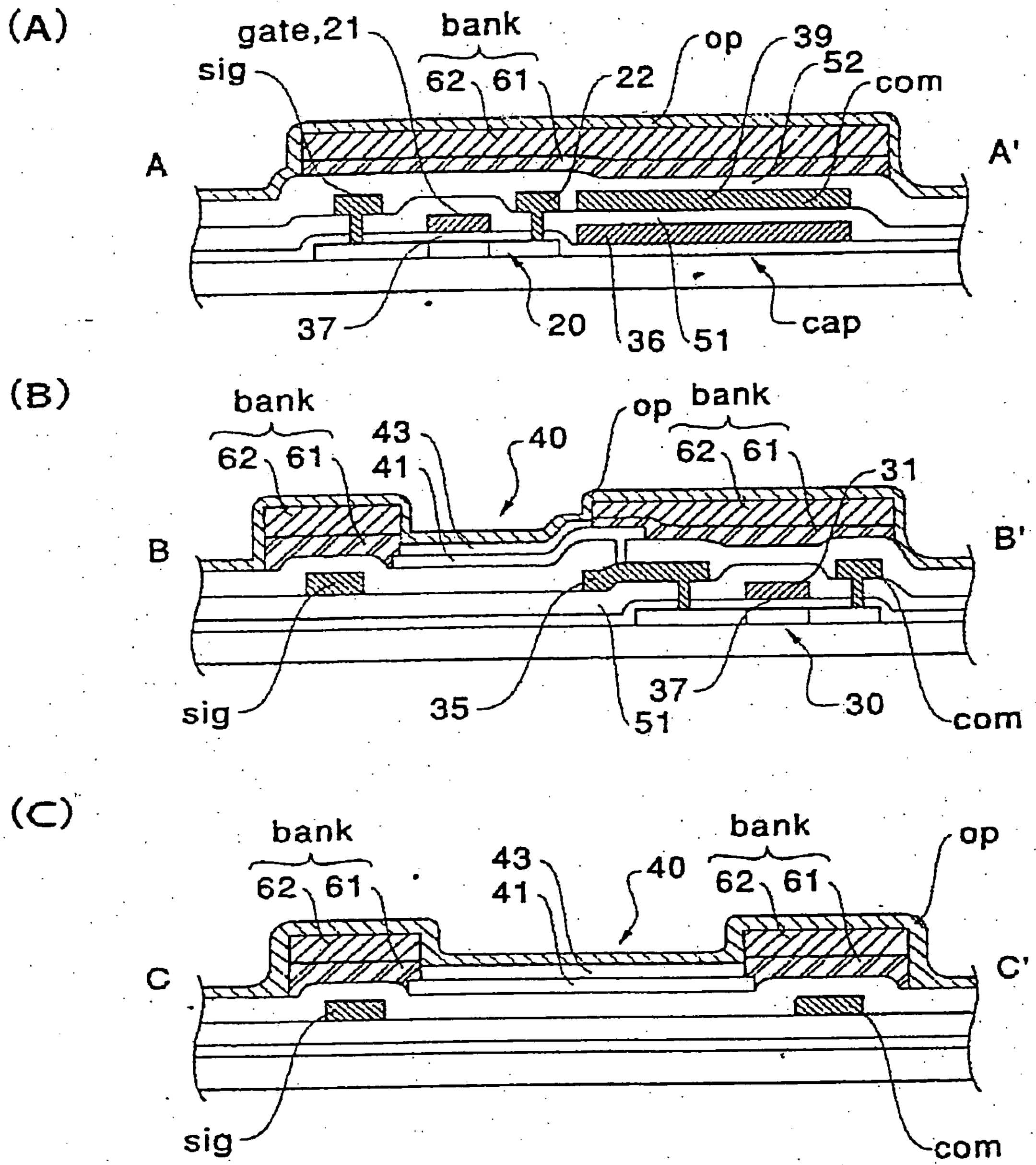

(A)
gate,21
bank
62 61
sig
22
op
39
52
com
A
A'
37
20
36
51
cap
(B)
bank
62 61
43
41
40
op
bank
62 61
31
B
B'
sig
35
51
37
30
com
(C)
bank
62 61
43
41
40
bank
62 61
op
C
C'
sig
com

Fig. 4

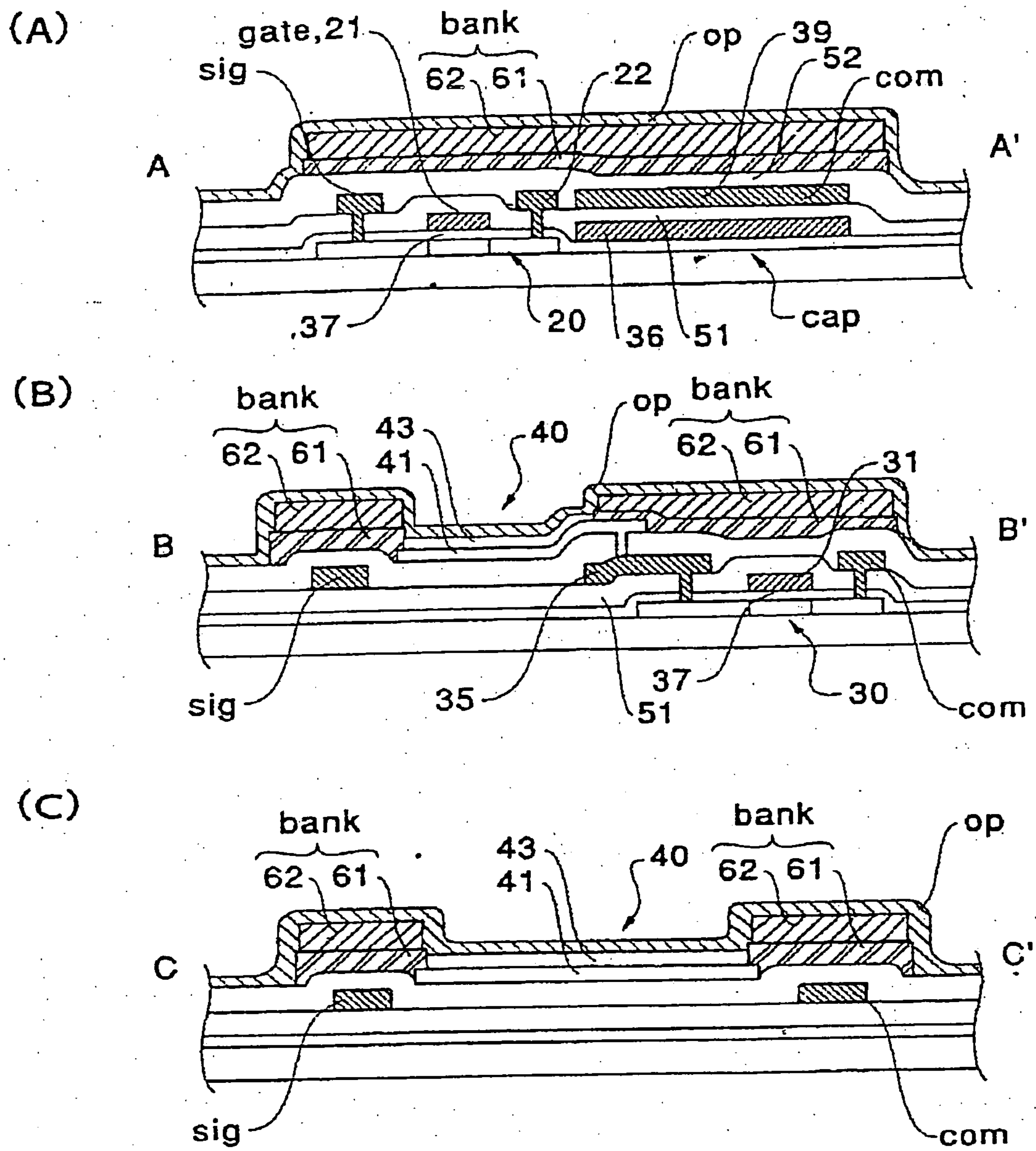

(A)
gate,21
bank
62
61
sig
22
op
39
52
com
A
A'
.37
20
36
51
cap
(B)
bank
62
61
43
41
40
op
bank
62
61
31
B
B'
sig
35
51
37
30
com
(C)
bank
62
61
43
41
40
bank
62
61
op
C
C'
sig
com

Fig. 5

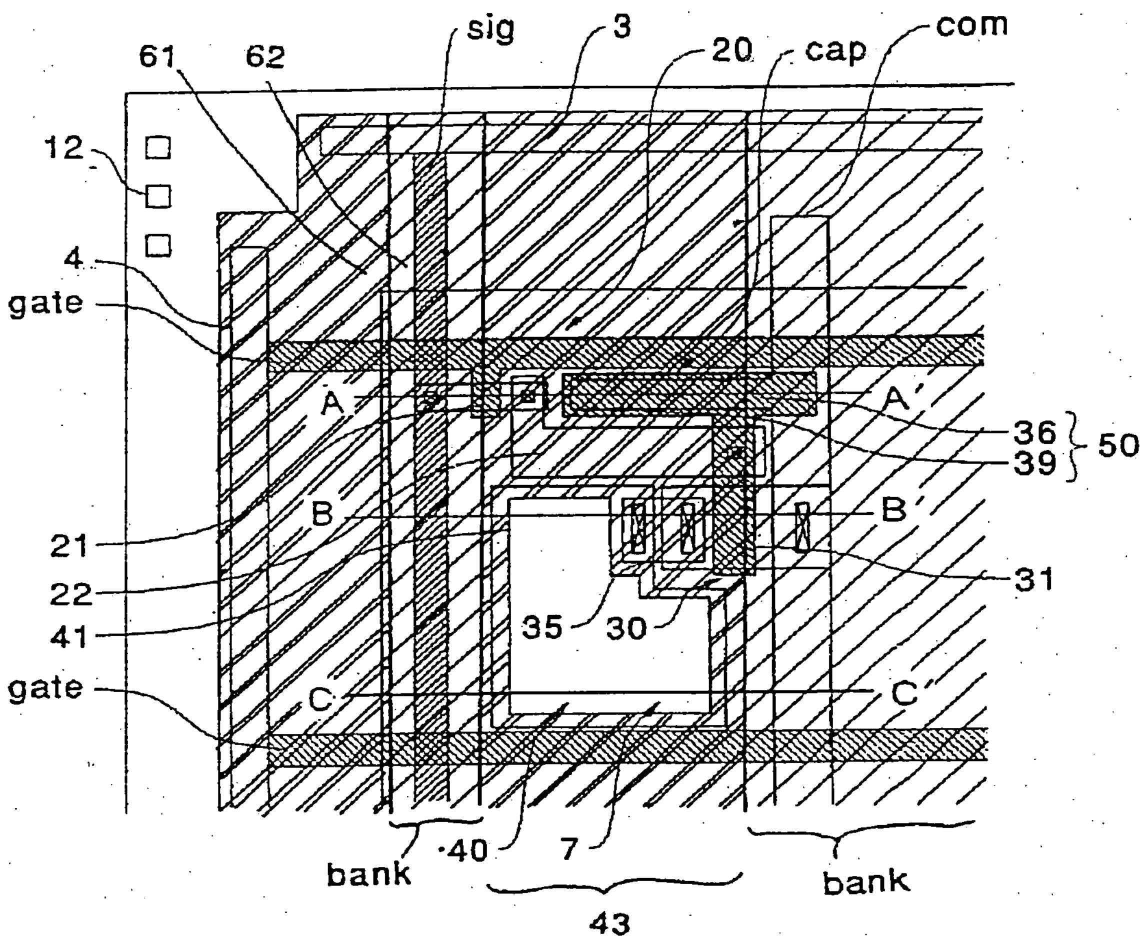

sig
3
20
cap
com
61
62
12
4
gate
A
A'
36
39
50
B
B'
21
22
41
35
30
31
gate
C
C'
bank
40
7
bank
43

Fig. 6

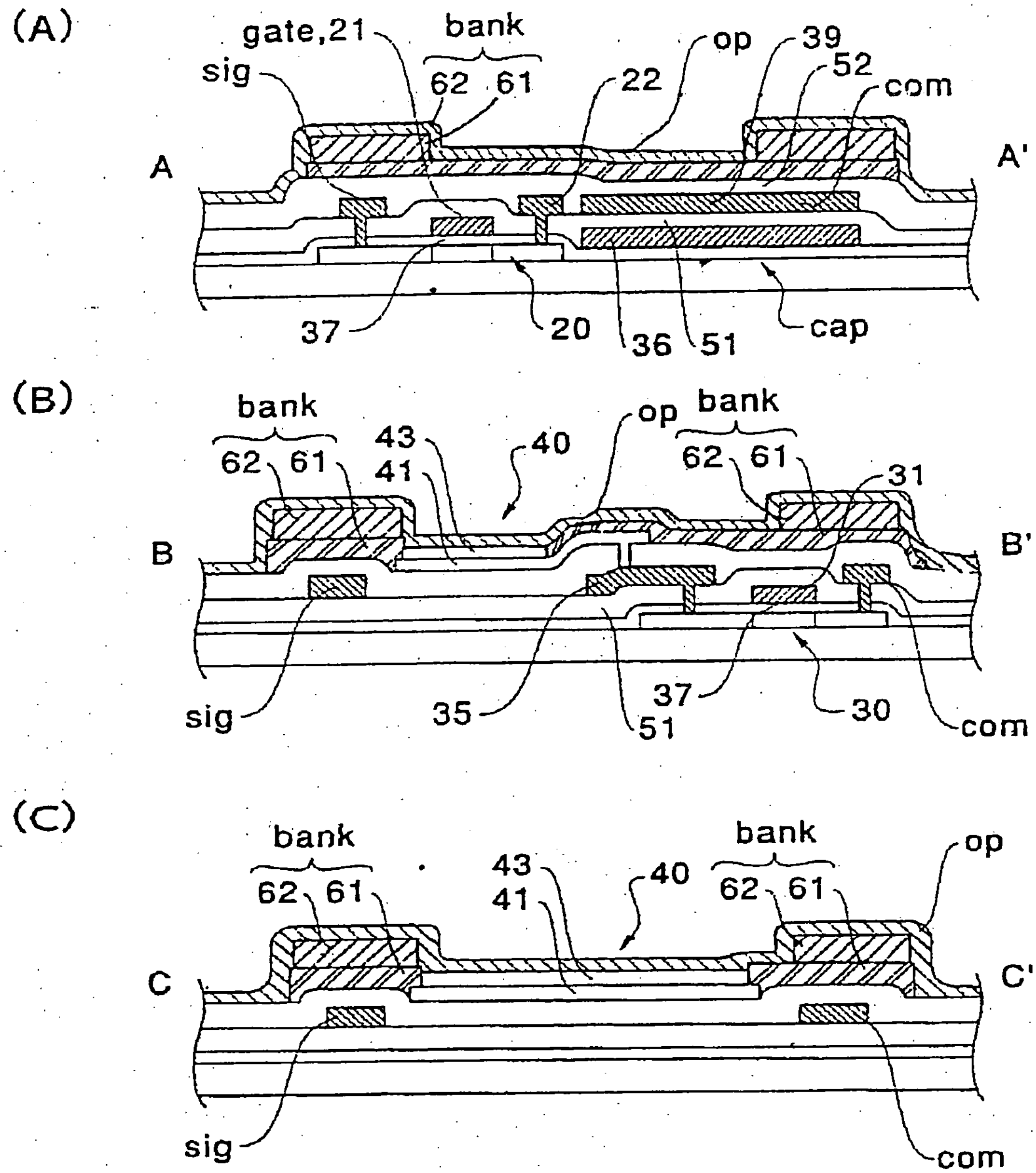

(A)
gate,21
bank
sig
62
61
22
op
39
52
com
A
A'
37
20
36
51
cap
(B)
bank
62
61
43
41
40
op
bank
62
61
31
B
B'
sig
35
51
37
30
com
(C)
bank
62
61
43
41
40
bank
62
61
op
C
C'
sig
com

Fig. 7

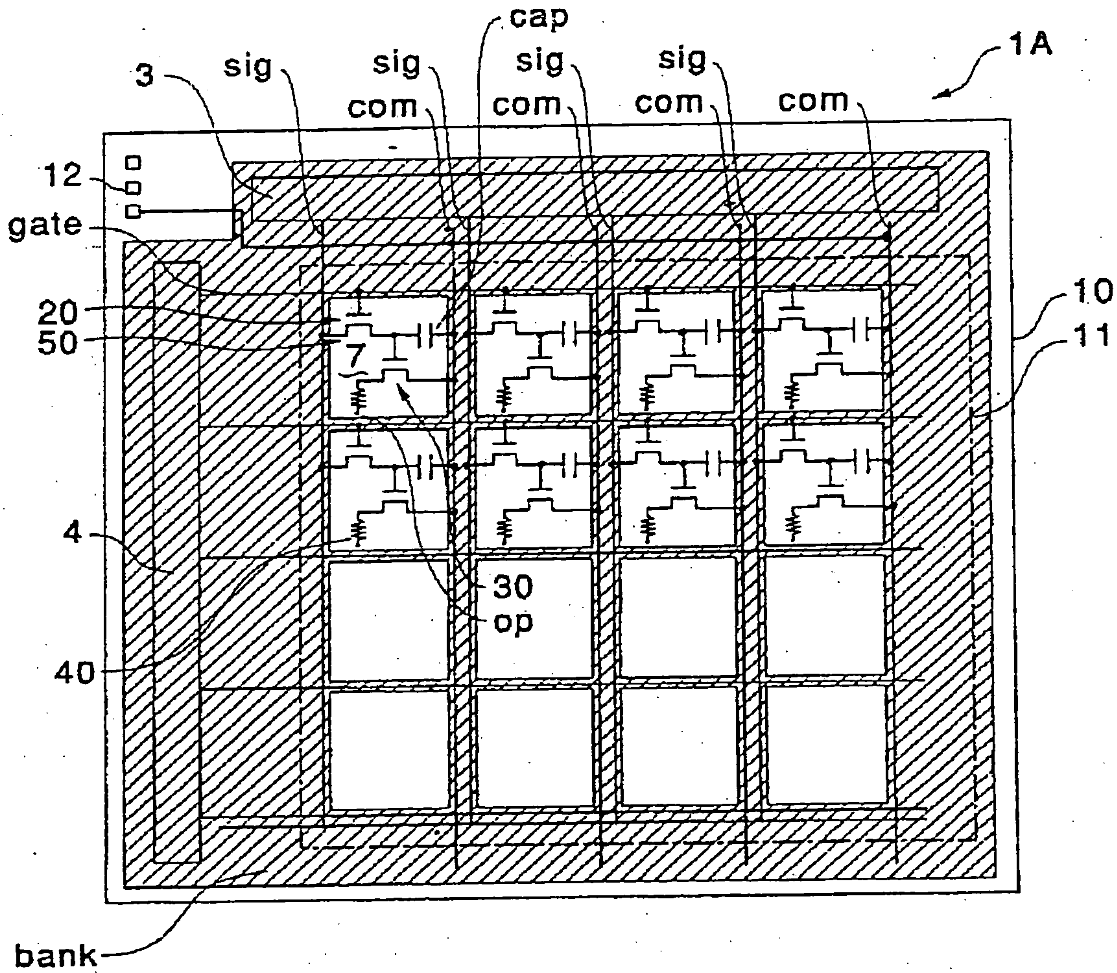

cap
1A
3
sig
sig
sig
sig
com
com
com
com
12
gate
20
50
7
10
11
4
30
op
40
bank

Fig. 8

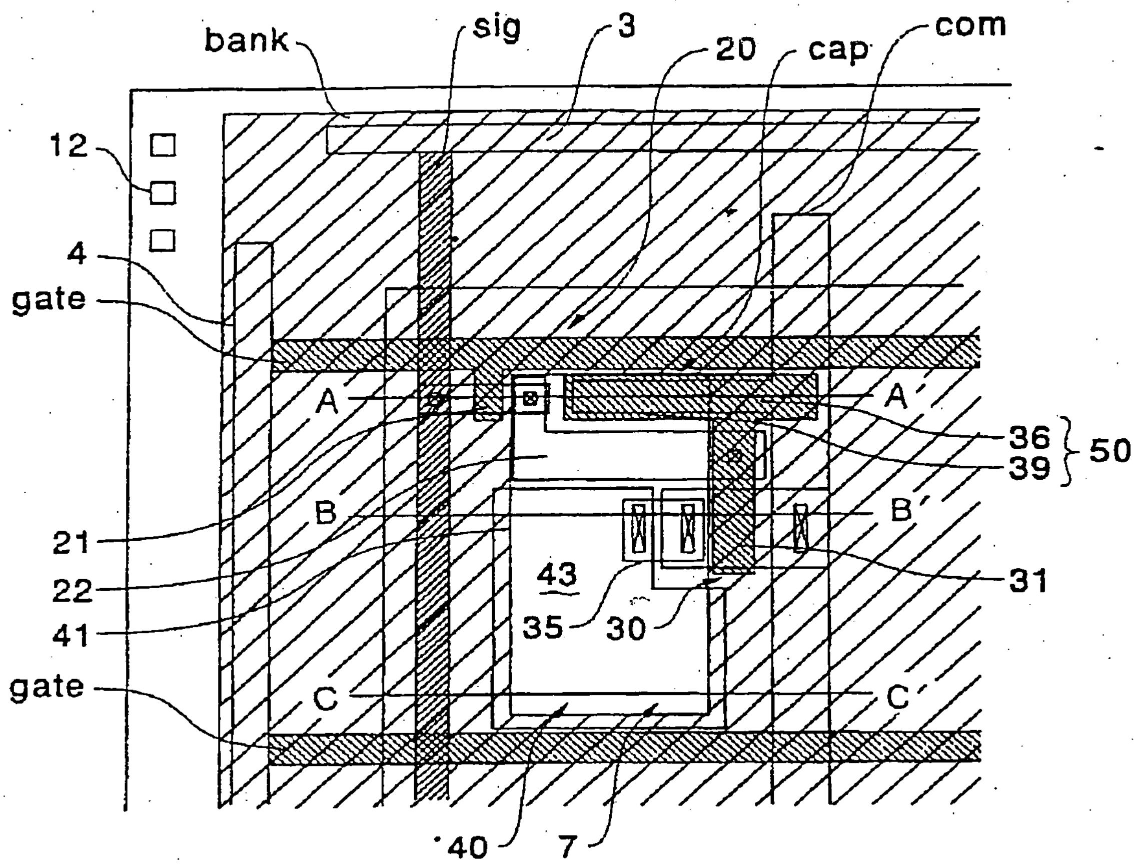

bank
sig
3
20
cap
com
12
4
gate
A
A'
36
39
50
B
B'
21
22
41
43
35
30
31
gate
C
C'
40
7

Fig. 9

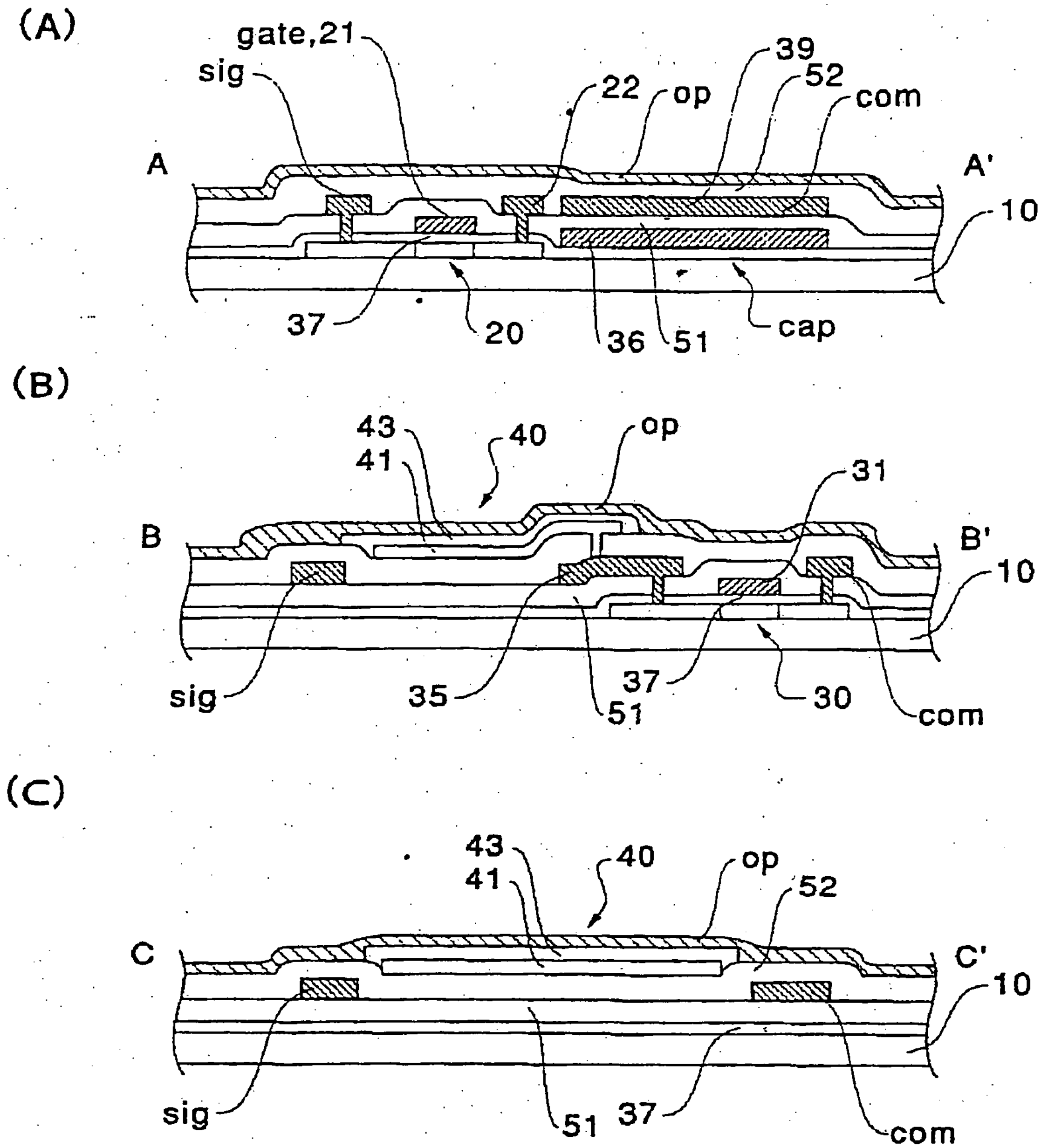
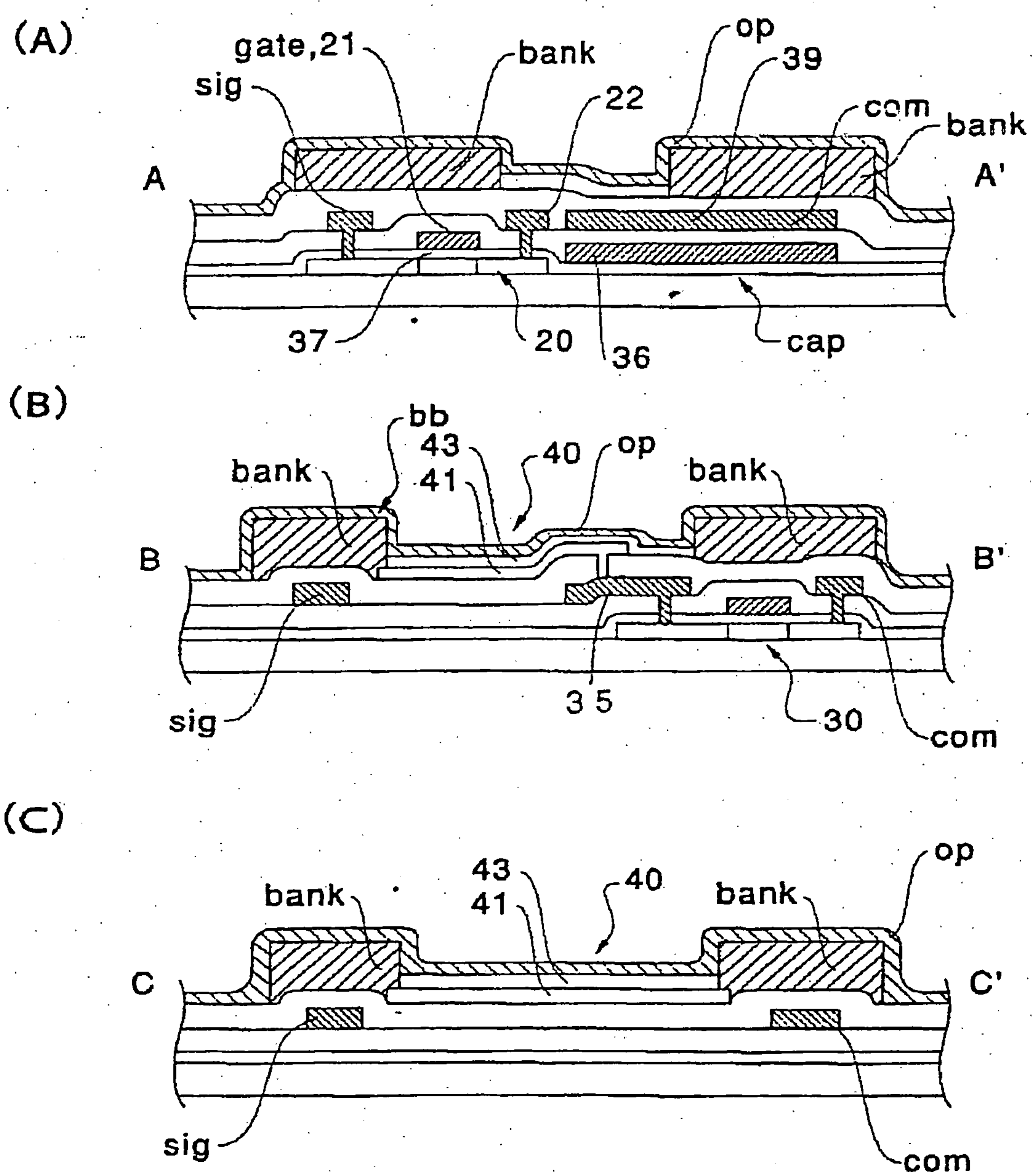

(A)
gate,21
sig
22
op
39
52
com
A
A'
10
37
20
36
51
cap
(B)
43
41
40
op
31
B
B'
10
sig
35
51
37
30
com
(C)
43
41
40
op
52
C
C'
10
sig
51
37
com

Fig. 10


(A)
gate,21
bank
op
39
sig
22
com
bank
A
A'
37
20
36
cap
(B)
bb
43
40
op
bank
41
bank
B
B'
sig
3 5
30
com
(C)
43
40
op
bank
41
bank
C
C'
sig
com

[Name of Document] Abstract

[Abstract]

[Object] To provide an active matrix display device, without damage of thin film luminescent devices, having a thick insulating film satisfactorily formed around an organic semiconductive film in the thin film luminescent devices.

[Solving Means] An active matrix display device 1 is provided with a bank layer **bank** along a data line **sig** and a scanning line **gate** to suppress formation of parasitic capacitance in the data line **sig**, in which the bank layer **bank** surrounds a region for forming the organic semiconductive film 43 of the thin film luminescent device 40 by an ink-jet process. The bank layer **bank** consists of a lower insulating layer 61 composed of a thick organic material and an upper insulating layer 62 of an organic material which is deposited on the lower insulating layer 61 and has a smaller thickness so as to avoid contact of the organic semiconductive film 41 with the upper insulating layer 62.

[Selected Drawing] Fig. 4